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UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 870

Contribution from the Bureau of Animal Industry
JOHN R. MOHLER, Chief

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EFFECT OF WINTER RATIONS ON PASTURE GAINS OF YEARLING STEERS.[1]

By E. W. SHEETS and R. H. TUCKWILLER, *Animal Husbandry Division.*[2]

I. WINTER RATIONS AND THEIR INFLUENCE ON PASTURE GAINS OF YEARLING STEERS.

II. THE USE OF SILAGE AND THE COST OF RATIONS FOR WINTERING YEARLING STEERS.

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OUTLINE OF THE EXPERIMENTAL WORK.

The work reported in this bulletin is part of a series of beef-cattle experiments that have been in progress since December 22, 1914, carried on in cooperation between the Bureau of Animal Industry of the United States Department of Agriculture and the West Virginia Agricultural Experiment Station on the farm of David Tuckwiller,

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[1] A report of cooperative work by the Bureau of Animal Industry, United States Department of Agriculture, and the West Virginia Agricultural Experiment Station.

[2] The authors acknowledge the services of W. F. Ward, formerly of the Animal Husbandry Division, who assisted in planning this experiment, and of F. W. Farley, J. B. Huyett, and E. A. Tuckwiller, formerly of the Animal Husbandry Division, who assisted in carrying on the work.

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in Greenbrier County, W. Va., to study beef-production problems in the Appalachian Mountain region. This farm is located in the southeastern part of the State in the blue-grass area. The results of this experiment apply not only to West Virginia but also to the adjacent States having similar conditions, as shown in the outline map (fig. 1). Some of the results and methods may be of such general application as to be utilized to advantage by cattle feeders in other parts of the country.

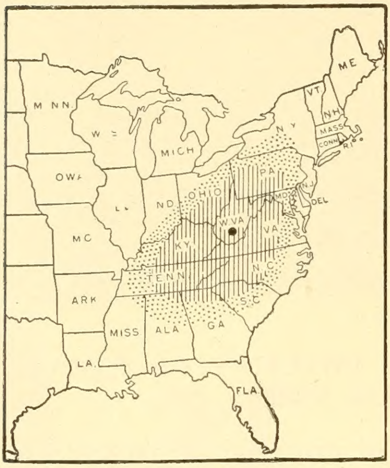

FIG. 1.—Map showing region to which this work applies. The black dot indicates the location of the farm on which the experiment was conducted. The shaded portion represents the area to which the results are applicable, and the dotted portion shows an additional area to which the results apply in part.

THE REGION AND THE PROBLEMS

The topography in most parts of the region, except in the vicinity of streams, is gently rolling or even mountainous in the higher elevations. The area is generally cleared of forest trees, although vast areas of cut-over or stump land are found. The farms vary in size from less than 100 acres to more than 1,000 acres. The land is especially well adapted for grazing purposes. In most sections there is tillable land for the production of abundant crops for winter feed or other purposes.

It is in this general area that a large percentage of the grass-finished cattle are produced, which go annually to eastern markets. The fact that most of the steers produced in this area are finished for market from grass alone attests the value of the pastures, which consist largely of blue grass. The use of grain for finishing cattle is not general, although there are many sections where the practice is followed, particularly in the valleys of the larger streams and on gently rolling areas. By far the larger number of farmers who handle beef cattle grow either stockers and feeders or finish cattle for market from grass alone. It therefore becomes one of the principal beef-production problems in this general area to determine the best and most economical method of wintering the cattle and the one that will enable them to make the best possible use of the pasture the following summer, the time when cheapest gains are made.

It has been a common practice in this area to winter steers on dry feed, such as hay, corn stover, and wheat straw, and on corn silage to a less extent, in a way that causes them to lose materially in weight. They are then pastured the following summer and sold

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from grass either as stockers or feeders or as finished steers for the market. There are some who hold the idea that it is profitable to permit this loss of weight, which with older steers often amounts to from 25 to 100 pounds. There are others who believe that cattle wintered on silage, or on a ration of which silage is a part, will not do well on grass the following summer.

OBJECTS AND PLAN OF THE WORK.

The objects of the experiments as a whole had these general problems in view:

1. To ascertain the effect of different wintering rations upon subsequent pasture gains.
2. To determine the most satisfactory and economical method of wintering.
3. To determine the best method and the cost of raising beef cattle in West Virginia.

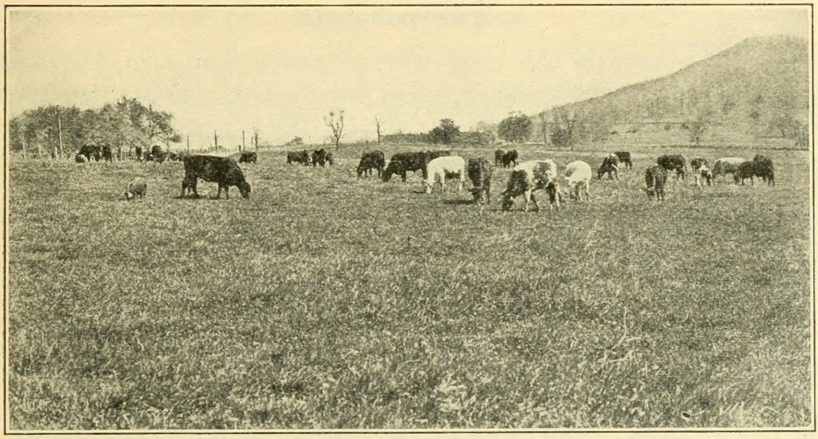

FIG. 2.—The first day on pasture, April 29, 1918, after the cattle had been wintered on a ration of corn silage, cottonseed meal, and wheat straw. (This picture shows the class of cattle, the general appearance of pasture, and the nature of the country.)

Two distinct phases of the problems as outlined in objects 1 and 2 presented themselves for solution: First, the wintering of yearlings that are to be pastured the following summer and sold as stockers or feeders; second, the wintering and subsequent grazing of older steers to be sold from grass when fat. The first, however, is the only one considered here, the second being reserved for further investigation.

The work was carried on for a period of four years, in order to have an average of feedstuffs, cattle, seasons, and other conditions tending to produce variation. The general plan of these experiments, including the rations used for the different lots of steers, is given in Table 1.

TABLE 1.—*Plan of the four years' work.*

Lot No.[1]	Season.	Steers in lot.	Winter feed.[2]	Summer feed.[3]
Lots 1..	1914–15	10	Corn silage, mixed hay, and wheat straw	Pasture.
	1915–16	10	.....do	Do.
	1916–17	10	.....do	Do.
Lots 2..	1914–15	10	Corn silage, wheat straw, and cottonseed meal	Do.
	1915–16	10	.....do	Do.
	1916–17	10	.....do	Do.
	1917–18	10	.....do	Do.
Lots 3..	1914–15	10	Mixed hay and wheat straw	Do.
	1915–16	10	.....do	Do.
	1916–17	10	.....do	Do.
	1917–18	10	.....do	Do.
Lot 4..	1917–18	10	Corn silage and soy-bean hay	Do.
Lot 5..	1917–18	10	Corn silage, rye hay, and cottonseed meal	Do.

[1] New lots of steers were used each year, totaling as follows: 1914, 30 steers; 1915, 30 steers; 1916, 30 steers; 1917, 40 steers.
[2] From time cattle were taken off pasture in December until turned on pasture, about May 1.
[3] From time cattle went on grass in spring until sold. Each summer all the steers were turned into the same pasture and had no feed except the grass.

KIND OF STEERS USED.

The steers used in this work were of grade Shorthorn, Hereford, and Aberdeen-Angus breeding. They were raised in southern West Virginia and were a good, uniform lot of cattle in age, weight, quality, and condition. They averaged from 650 to 675 pounds in weight at the beginning of the winter period and were 1 year old the previous spring.

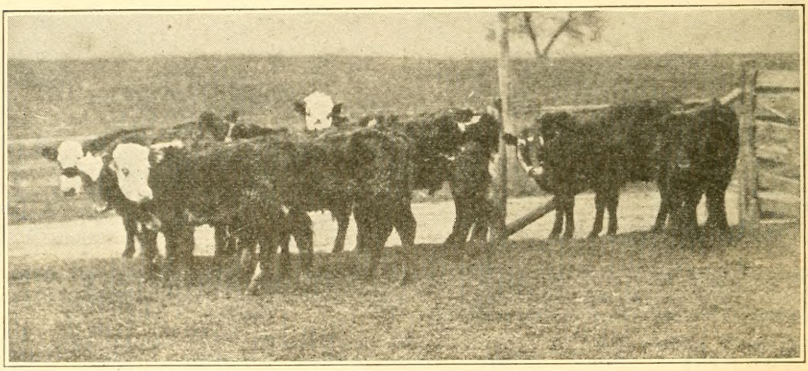

FIG. 3.—Steers in Lot 1 at end of winter feeding, 1917-18.

FEEDS USED.

Samples of each of the feeds used were taken at different times throughout the four winter feeding periods and sent to the Department of Chemistry, West Virginia Experiment Station, Morgantown, W. Va., and there analyzed, with the results shown in Table 2.

TABLE 2.—*Composition of feeds used.*

Feeds.	Analyses (actual) as made at the West Virginia Experiment Station.				Analyses (average) as given in Henry's "Feeds and Feeding."			
	Protein.	Carbohydrates, including fiber.	Fat.	Ash.	Protein.	Carbohydrates, including fiber.	Fat.	Ash.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Corn silage	1.86	21.52	0.53	1.13	2.1	21.7	0.8	1.7
Mixed hay	6.60	79.49	1.90	3.74	8.6	70.7	2.4	6.1
Wheat straw	2.86	84.11	1.38	3.21	3.1	81.8	1.5	5.2
Rye hay	5.79	79.82	1.19	4.75	6.7	78.0	2.1	5.1
Soy-bean hay	10.00	68.90	3.02	9.08	16.0	64.0	2.8	8.6
Cottonseed meal (good)	37.58	40.34	8.29	6.05	37.6	39.9	8.2	6.4

From the analyses it is evident that the feeds used, with the exception of cottonseed meal, were somewhat below the average in quality. The cottonseed meal used was of 41 per cent protein the first year and of 36 per cent protein the last three years. The silage was made from a mixture of dent and silage corn.

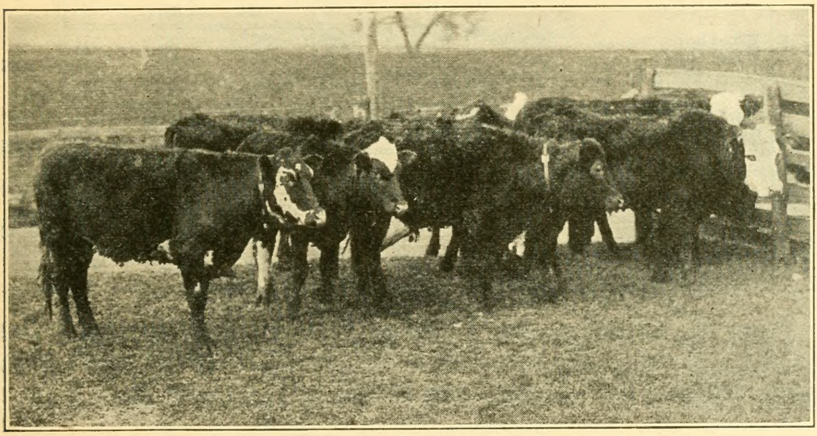

FIG. 4.—Steers in Lot 2 at end of winter feeding, 1917–18.

A three-year rotation of crops, consisting of corn, wheat, and hay, is practiced pretty generally in the section under discussion. Timothy is sown with the wheat in the fall, and clover is sown on the same field in the spring. This provides in the year following the wheat crop a mixed hay of timothy and clover. The mixed hay used in this work was obtained in this manner.

In making soy-bean hay the ground is prepared about the same as it would be for corn. The beans are drilled broadcast, using 1½ bushels per acre. They are usually sown the last of May or the first of June, after all danger of heavy frost is past. When the beans begin to form in the pods, about the first of September, the time varying with the variety of beans and the kind of season, the crop is cut and cured for hay.

In making rye hay the seed is sown in the fall, as it would be for raising grain, except that more seed per acre is used. In the spring just before the rye blooms it is cut and cured.

The composition and nutritive ratio of the rations fed are given in Table 3.

TABLE 3.—*Dry matter, protein, carbohydrates, fat, and nutritive ratio of rations fed each year.*

Lot No.	Ration.	Average quantity per steer daily.	Composition.				Nutritive ratio.
			Dry matter.	Protein.	Carbohydrates.	Fat.	
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
1	Corn silage	20.0	5.26	0.220	3.000	0.140	1 :14.5
	Mixed hay	5.0	4.39	.200	1.985	.055	
	Wheat straw	2.54	2.33	.018	.891	.013	
		....	11.98	.438	5.876	.208	
2	Corn silage	23.1	6.08	.254	3.465	.162	1 :9.7
	Wheat straw	4.9	4.49	.034	1.720	.025	
	Cottonseed meal	1.0	.93	.334	.243	.079	
		....	11.50	.622	5.428	.266	
3	Mixed hay	11.9	10.45	.476	4.724	.131	1 :12.9
	Wheat straw	4.07	3.73	.028	1.429	.020	
		....	14.18	.504	6.153	.151	
4	Corn silage	20.0	5.26	.220	3.000	.140	1 :6.3
	Soy-bean hay	6.0	5.48	.702	2.352	.072	
		....	10.74	.922	5.352	.212	
5	Corn silage	20.0	5.26	.220	3.000	.140	1 :10.9
	Rye hay	6.0	5.51	.204	2.760	.066	
	Cottonseed meal	.5	.46	.167	.122	.039	
		....	11.23	.591	5.882	.245	

From the foregoing table it is seen that the quantity of dry matter fed was practically the same in all lots, the chief difference in the ration being in the proportion of protein to carbohydrates.

CHARACTER OF PASTURE.

Each year the steers were turned on a rather rough pasture of about 160 acres, one-fourth of which is in woodland. The pasture is situated in a valley between two small mountains, and a small stream which flows through it provides an abundance of fresh water at all times throughout the summer.

The soil is of limestone formation, and a good growth of blue grass with much white clover is found on all parts of the pasture not in timber. Under normal climatic conditions there is rainfall enough to keep the grass growing throughout the season. The latter part of the summer of 1917 was rather dry, however, and during August of that year the steers made but small gains.

METHOD OF FEEDING AND HANDLING THE STEERS.

In the fall before starting the steers on the winter feed they were divided into lots of 10 each. In this division care was taken to have the lots as nearly the same as possible in regard to quality, breeding, size, and condition. These different lots were given the same amount of space in open sheds with small outside lots about 30 by 60 feet in size. Water was supplied in these lots at all times, and salt was constantly available. The cattle were fed twice a day.

The feed, both concentrates and roughages, was weighed each time and accurate records of it made. The steers were weighed at the beginning and at the end of the feeding period, the weights being taken 3 days in succession and an average taken for their initial and final weight. They were weighed also every 28 days. For identification, neck straps with numbers on them were used and individual weights taken in the morning after feeding.

I. WINTER RATIONS AND THEIR INFLUENCE ON PASTURE GAINS OF YEARLING STEERS.

QUANTITY OF FEED CONSUMED.

In considering the quantity of feed consumed it should be kept in mind that these cattle were getting only maintenance rations, but enough to keep them in good, strong, thrifty condition. Table 4 shows the total amount of different feeds eaten in the various lots and the average daily ration per steer in each lot during each of the four winters.

TABLE 4.—*Average total and daily rations during four winters.*

1914–15.

Lot No.	Number of steers.	Days.	Ration.	Total feed per steer.	Daily feed per steer.
				Pounds.	*Pounds.*
1	10	128	Corn silage	2,111.5	17.0
			Mixed hay	653.0	5.0
			Wheat straw	429.0	3.4
2	10	128	Corn silage	3,105.0	25.0
			Wheat straw	561.0	4.3
			Cottonseed meal	127.5	1.0
3	10	128	Mixed hay	1,278.5	10.0
			Straw	602.5	4.7

1915–16.

Lot No.	Number of steers.	Days.	Ration.	Total feed per steer.	Daily feed per steer.
1	10	122	Corn silage	2,440.0	20.0
			Mixed hay	610.0	5.0
			Wheat straw	265.0	2.2
2	10	122	Corn silage	3,050.0	25.0
			Wheat straw	610.0	5.0
			Cottonseed meal	122.0	1.0
3	10	122	Mixed hay	1,464.0	12.0
			Straw	530.0	4.3

TABLE 4.—*Average total and daily rations during four winters*—Continued.

1916-17.

Lot No.	Number of steers.	Days.	Ration.	Total feed per steer.	Daily feed per steer.
				Pounds.	*Pounds.*
1	10	134	Corn silage	3,015.0	22.5
			Mixed hay	670.0	5.0
			Wheat straw	271.0	2.02
2	10	134	Corn silage	3,015.0	22.5
			Wheat straw	628.0	4.69
			Cottonseed meal	134.0	1.0
3	10	134	Mixed hay	1,622.0	12.1
			Wheat straw	611.0	4.56

1917-18.

Lot No.	Number of steers.	Days.	Ration.	Total feed per steer.	Daily feed per steer.
2	10	133	Corn silage	2,660.0	20.0
			Wheat straw	738.0	5.55
			Cottonseed meal	135.0	1.0
3	10	133	Mixed hay	1,782.2	13.4
			Wheat straw	359.1	2.7
4	10	133	Silage	2,660.0	20.0
			Soy-bean hay	798.0	6.0
5	10	133	Silage	2,660.0	20.0
			Rye hay	798.0	6.0
			Cottonseed meal	66.5	0.5

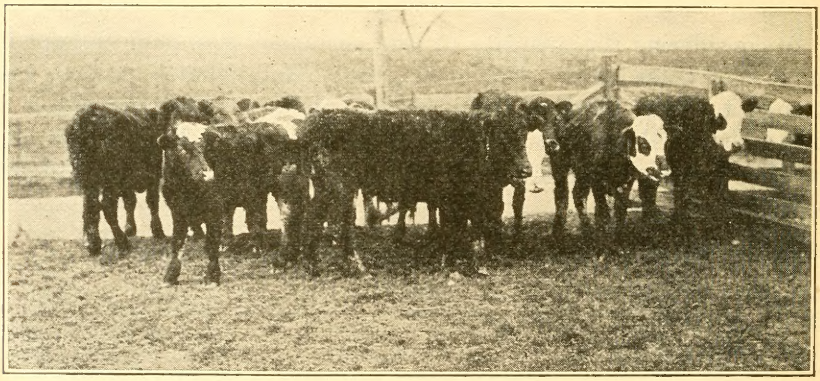

FIG. 5.—Steers in Lot 3 at end of winter feeding, 1917-18.

GAINS AND LOSSES DURING WINTER.

The gains and losses in weight during each of the four winters are shown in Table 5.

TABLE 5.—*Total and daily gains and losses during four winters.*

1914-15.

Lot No.	Number of steers.	Days.	Ration.	Average initial weight per steer.	Average final weight per steer.	Total gain (+) or loss (−) per steer.	Average daily gain or loss per steer.
				Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
1	10	128	Corn silage, mixed hay, and wheat straw	622	599	−23	−0.18
2	10	128	Corn silage, wheat straw, and cottonseed meal	618	692	+74	+ .58
3	10	128	Mixed hay and wheat straw	623	577	−46	− .36

TABLE 5.—*Total and daily gains and losses during four winters*—Continued.

1915-16.

Lot No.	Number of steers.	Days.	Ration.	Average initial weight per steer.	Average final weight per steer.	Total gain (+) or loss (−) per steer.	Average daily gain or loss per steer.
				Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
1	10	122	Corn silage, mixed hay, and wheat straw	678	678	00	00
2	10	122	Corn silage, wheat straw, and cottonseed meal	678	758	+80	+ .66
3	10	122	Mixed hay and wheat straw	678	671	− 7	− .06
1916-17.							
1	10	134	Corn silage, mixed hay, and wheat straw	690	709	+19	+ .14
2	10	134	Corn silage, wheat straw, and cottonseed meal	690	742	+52	+ .39
3	10	134	Mixed hay and wheat straw	689	659	−30	− .22
1917-18.							
2	10	133	Corn silage, wheat straw, and cottonseed meal	671	711	+40	+ .30
3	10	133	Mixed hay and wheat straw	671	615	−56	+ .421
4	10	133	Corn silage and soy-bean hay	671	698	+27	+ .203
5	10	133	Corn silage, rye hay, and cottonseed meal.	671	682	+11	+ .083

Table 5 shows that in 1914–15 the cattle in Lot 1 fed on silage, mixed hay, and straw lost an average of 23 pounds in 128 days during the winter, equal to a daily loss of 0.18 pound per steer. In 1915–16 the lot fed the same ration neither lost nor gained weight during the 122 winter days. In 1916–17 the lot fed the same ration gained an average of 19 pounds, equal to a daily gain of 0.14 pound per steer.

Lot 2 in 1914–15, fed on silage, straw, and cottonseed meal, gained an average of 74 pounds in 128 days, equal to a daily gain per steer of 0.58 pound. The next year the corresponding lot gained 80

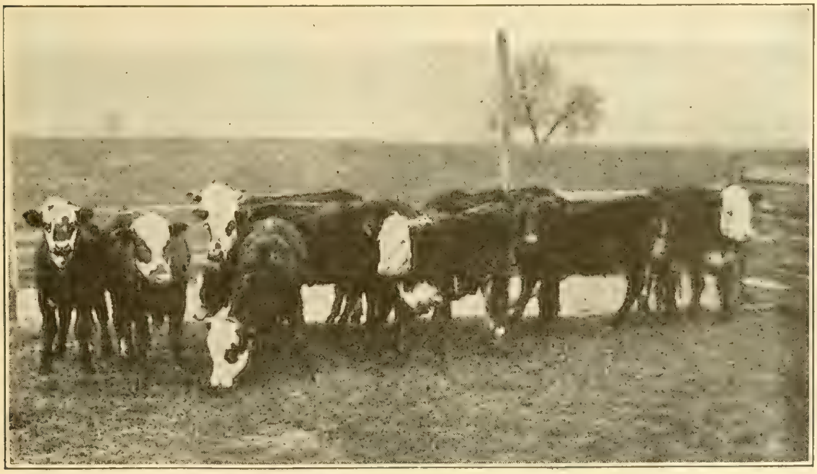

FIG. 6.—Steers in Lot 4 at end of winter feeding, 1917–18.

pounds in 122 days, making a daily gain of 0.66 pound per steer. In 1916–17 the corresponding lot gained 52 pounds per steer in 134 days, making an average daily gain of 0.39 pound. In 1917–18 the corresponding lot gained 40 pounds per steer in 133 days, making an average daily gain of 0.3 pound.

Lot 3 in 1914–15, fed on mixed hay and wheat straw with no silage, lost an average of 46 pounds, equal to a daily loss of 0.36 pound per steer. The corresponding lot in 1915–16 lost 7 pounds, equal to a daily loss of 0.06 pound per steer. In 1916–17 the corresponding lot lost 30 pounds, making an average daily loss of 0.22 pound per steer. In 1917–18 the corresponding lot lost 56 pounds, equal to a daily loss per steer of 0.42 pound.

The lot fed silage and soy-bean hay in 1917–18 gained an average of 27 pounds in 133 days, making a daily gain per steer of 0.2 pound. In 1917–18 the lot fed silage, rye hay, and cottonseed meal gained 11 pounds per steer in 133 days, or an average daily gain of 0.08 pound.

GAINS DURING SUMMER.

In the spring of each year as soon as the grass was good enough, which was usually about May 1, the steers from all the lots were turned into the same pasture on grass with no additional feed. Weights were taken every 28 days, just as during the winter. Thus the effect of the different rations upon the summer grazing of the different lots could be studied.

Table 6 shows the weights at the beginning of the grazing period, the weights at the end of the grazing period, and the total and average gains per steer for the summer period.

TABLE 6.—*Total and daily gains during four summers on pasture alone.*

Lot No.	Number of steers.	Days on pasture.	Average weight per steer at beginning of grazing period.	Average final weight per steer.	Total gain per steer for summer.	Average daily gain per steer.
1914–15.						
			Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
1	10	168	599	935	336	2.0
2	10		692	947	255	1.5
3	10		577	892	315	1.87
1915–16.						
	10	167	678	1,022	344	2.1
2	10		758	1,036	278	1.7
3	10		671	981	310	1.9
1916–17.						
1	10	157	709	979	270	1.7
2	10		742	1,000	258	1.6
3	10		659	965	306	1.9
1917–18.						
2	10	140	711	969	258	1.8
3	10		615	920	305	2.2
4	10		698	938	240	1.7
5	10		682	963	281	2.0

GAINS AND LOSSES, WINTER AND SUMMER.

The gains and losses in weight in both winter and summer are summarized in Table 8, and averages are shown for lots fed on the same rations in different years.

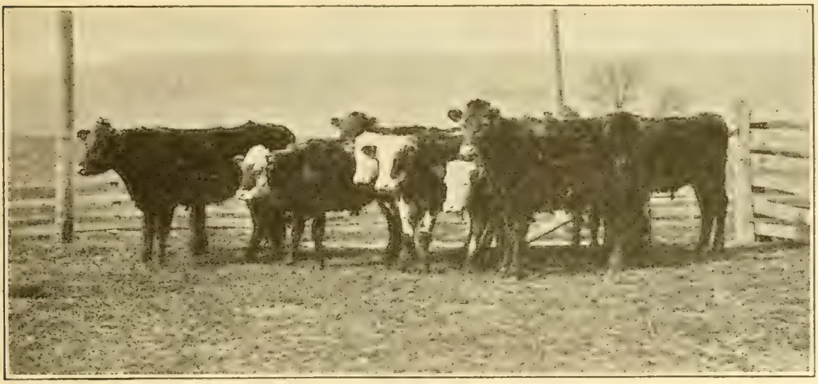

FIG. 7.—Steers in Lot 5 at end of winter feeding, 1917–18.

TABLE 7.—*Summary of gains and losses in weight per steer, winter and summer.*

Lot No.	Ration.	Year.	Gain (+) or loss (−) in weight per steer in winter.	Gain in weight per steer in summer.	Total gain in weight per steer, winter and summer.
			Pounds.	*Pounds.*	*Pounds.*
1	Corn silage, mixed hay, and wheat straw	1914–15	−23	336	313
		1915–16	+00	344	344
		1916–17	+19	270	289
	Average		− 1	317	316
2	Corn silage, wheat straw, and cottonseed meal	1914–15	+74	255	328
		1915–16	+80	278	358
		1916–17	+52	258	3 0
		1917–18	+40	258	298
	Average		+62	262	324
3	Mixed hay and wheat straw	1914–15	−46	315	269
		1915–16	− 7	310	303
		1916–17	−30	306	276
		1917–18	−56	305	249
	Average		−35	309	274
4	Corn silage and soy-bean hay	1917–18	+27	240	267
5	Corn silage, rye hay, and cottonseed meal	1917–18	+11	281	292

GRAPHIC PRESENTATION OF GAINS AND LOSSES.

The comparative rapidity and extent of gains and losses can be shown more clearly by the use of a chart than in any other way. Accordingly a chart is presented herewith as figure 8, which shows the average changes in weight of the steers of the three lots.

Horizontal distance on the chart indicates the number of days that the steers were fed during the winters and pastured during the summers. The average length of the total period for the 4 years was 288 days, of which 130 days were in the winter or feeding period and the remaining 158 in the summer or grass period. The heavy black vertical line near the center of the chart marks the dividing line between the winter and summer periods.

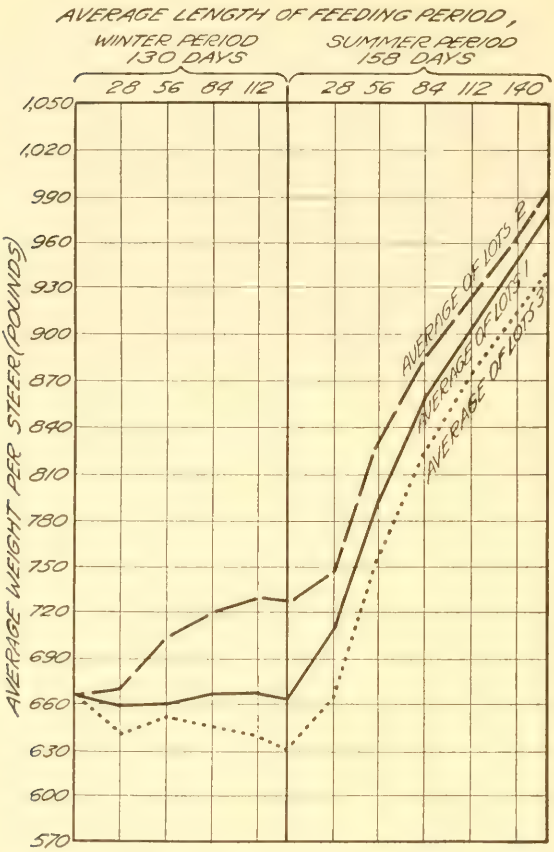

FIG. 8.—Diagram showing average variations in weights of 3 lots of steers during summer and winter feeding periods.

Vertical distance on the chart represents changes in live weight of the steers. The weights corresponding to each of the horizontal lines are given along the left side of the chart.

Some rather striking facts as to the way steers on different rations vary in weight from period to period during the winter are brought out. It will be noted that in Lots 1 and 3 there was an actual loss in weight each year during the first period of the winter. By the end of the second period this tendency to lose in weight had been overcome, and in most of the trials a slight gain was made during this period. While the average of Lot 2 showed a small gain during the first period, it is evident that the rapidity of gain was greatly increased during the second period.

With one or two exceptions there was a marked loss in weight of steers in all lots during the last 18 days of the winter period. This falling off in weight can, no doubt, be attributed to the fact that the coming of the pasture season caused the steers to eat less dry feed and possibly to make less efficient use of what they did eat. Cattle fed on dry feed during the winter become restless with the appearance of grass and lose their appetites for the dry and less appetizing feeds which they have been receiving.

There are some very noticeable differences in the gains made by the different lots during the first 28 days of the pasture season. With one exception all lots in each trial took on weight. The steers of Lot 3 during this first period of the spring of 1917 actually lost 2 pounds per head while on grass. There is no apparent explanation for this loss, in view of the fact that both Lots 1 and 2 made gains during this same month. Since all the steers were in the same pasture and received the same treatment, no satisfactory reason for the loss by the steers of this one lot can be advanced.

As would be expected, the cattle which had been fed on a ration that caused them to lose weight during the winter made the greatest gains during this first month on pasture. The steers which had been fed on a ration of corn silage, cottonseed meal, and wheat straw and which made a steady gain throughout the winter did not make so large a gain from grass during this first period as did the steers of Lot 3, which lost weight in the winter.

The greatest gains from pasture were made by the steers of Lot 1, although the difference between this lot and Lot 3 is so slight as to be almost negligible. While the summer gains of the steers of Lot 2, fed silage, cottonseed meal, and straw, were not so large as those of the other two lots, the total of both winter and summer gains shows an increase of 49 pounds over the gain made by the steers fed mixed hay and wheat straw and 14 pounds over those fed corn silage, mixed hay, and wheat straw.

CONCLUSIONS.

1. An average daily ration of 19.8 pounds of corn silage, 5 pounds of mixed hay, and 2.5 pounds of wheat straw fed to average good steers weighing 663 pounds (Lot 1) for 130 days during the winter should maintain them without a loss in weight.
2. An average daily ration of 23.1 pounds of corn silage, 4.9 pounds of wheat straw, and 1 pound of cottonseed meal fed to average good steers weighing 664 pounds (Lot 2) for 130 days during the winter should maintain their weight and allow an average gain of 62 pounds per steer.
3. An average daily ration of 11.9 pounds of mixed hay and 4.1 pounds of wheat straw fed to average good steers weighing 665 pounds (Lot 3) for 130 days during the winter will not maintain their weight but will result in an average loss of weight of approximately 35 pounds.
4. The steers in Lot 2 receiving a protein concentrate in the ration did not lose weight as did Lots 1 and 3 (fig. 5).
5. The steers receiving corn silage as a part of their ration (Lots 1 and 2, Table 7) made greater total gains for the year than those receiving rations of dry roughage alone.

6. Steers wintered on dry roughage alone (Lot 3), which lost weight during the winter, and those fed a maintenance ration only of which corn silage was a part (Lot 1) made greater gains during the first two months on grass than those steers (Lot 2) which had made considerable gain (60 pounds) during the winter. This would be expected if the steers in the first-mentioned lots were to be finished in the same condition as those in Lot 2, as they had considerably more gain to make in order to catch up in weight.

7. There was a slight tendency for the steers fed on dry roughage alone (Lot 3) to make less gain during the last two months of the pasture season than did the steers which had received silage in the ration (Lots 1 and 2) during the preceding winter, although this difference was very slight.

II. THE USE OF SILAGE AND THE COST OF RATIONS FOR WINTERING YEARLING STEERS.

Shall I purchase steers (that are to be fattened from grass the next summer) in the fall, and carry them through the winter largely on roughage, or shall I purchase them in the spring after some one else has wintered them? This is a question which the thoughtful cattle grazer in the good pasture areas is likely to ask himself and which it is of considerable importance to answer correctly. No matter what the answer may be on any particular farm or in any particular section of country, the fact remains that cattle are higher in price and are worth more in the spring just before the grass season opens than they were at the close of the pasture period the preceding fall. This increase in value is due largely to the cost of wintering, depending upon the rations and methods used.

The data already presented in this bulletin afford an opportunity to throw some light upon this important subject. In the following discussion of this question it is necessary to fix the prices for feeds on the farm. It is felt, however, that this is the most questionable and unsatisfactory part of such experimental work, and is especially true for the last few years, during which unusual fluctuations have occurred in feed prices.

PRICES OF FEEDS USED.

During the four years that this experiment was in progress the price of silage increased from $4 to $8 a ton, cottonseed meal from $30 to $60, and hay and straw advanced respectively 33⅓ and 50 per cent. Thus the cost of wintering a steer in 1917–18 was nearly double the cost of keeping him through the winter 1914–15. While feed prices remain high, it is not certain that they will continue at the present high level for any great length of time. For this reason, and also for simplicity in making the various calculations, an average of the feed prices for the four years is used, as follows:

	Per ton.
Corn silage	$6
Mixed hay	18
Rye hay	18
Soy-bean hay	17
Wheat straw	7
Cottonseed meal	50

The foregoing averages were made from figures taken from the Yearbook of the United States Department of Agriculture, and are the average farm prices in the States of West Virginia, Virginia, Maryland, Pennsylvania, Ohio, Kentucky, Tennessee, North Carolina, and parts of other adjacent States, to which this work is most applicable.

An attempt is made to show the comparative cost of the different rations for the benefit of those who desire information on this phase of the subject. If the prices of feeds in any locality are different from the prices used in these calculations, it is suggested that they be substituted and the following calculations used as a guide, using, as the basis of calculation, the total amounts of the different feeds consumed per steer as shown in the first section of Table 4.

Table 8 shows the rations fed, the gain or loss in weight per steer during the winter, the fall cost per hundredweight, the cost of feeding each steer through the winter, and the advance in spring value over fall cost of steers per hundredweight.

TABLE 8.—*Summary of rations, costs, and results.*

Lot No.	Ration.	Year.	Gain (+) or loss (−) in weight per steer.	Initial value per hundredweight.	Cost to winter each steer.	Value in spring per hundredweight.	Advance in spring value over initial value per hundredweight.
			Pounds.				
1	Corn silage, mixed hay, and wheat straw.	1914–15	−23	$6.50	$13.71	$9.04	$2.54
		1915–16	00	6.50	13.74	8.52	2.02
		1916–17	+19	7.00	16.03	9.07	2.07
	Average		− 1	6.67	14.49	8.88	2.2
2	Corn silage, wheat straw, and cottonseed meal.	1914–15	+74	6.50	14.47	7.89	1.39
		1915–16	+80	6.50	14.34	7.70	1.20
		1916–17	+52	7.00	14.60	8.48	1.48
		1917–18	+40	7.50	13.88	9.03	1.53
	Average		+62	6.88	14.32	8.28	1.40
3	Mixed hay and wheat straw	1914–15	−46	6.50	13.62	9.38	2.88
		1915–16	− 7	6.50	15.03	8.81	2.31
		1916–17	−30	7.00	16.74	9.72	2.72
		1917–18	−56	7.50	17.30	11.00	3.50
	Average		−35	6.88	15.67	9.73	2.85
4	Corn silage and soy-bean hay	1917–18	+27	7.50	14.76	9.32	1.82
5	Corn silage, rye hay, and cottonseed meal.	1917–18	+11	7.50	16.82	9.84	2.34

NOTE.—The length of the feeding period varied somewhat from year to year, depending on the condition of the pastures in the early spring. The steers were fed 128 days during the winter of 1914–15, 122 days in 1915–16, 134 days in 1916–17, and 133 days in 1917–18.

COST PER POUND OF GAIN.

The cost of producing a pound of gain is the main factor in determining whether a steer is being produced at a profit or a loss. The cost of feeding a steer during the winter, plus the cost of pasture the following summer, is the total cost of feeding the steer for the year. By dividing this amount by the increase in weight of the steer, the cost of producing a pound of gain may be ascertained. From Table 8 it will be noted that the winter cost constitutes approximately two-thirds of the total cost for the year. Practically all the gain, however, is made during the summer or pasture season. Hence the cost of wintering becomes the governing factor in determining the cost of a pound of gain. A summary of gains and costs is given in Table 9.

TABLE 9.—*Summary of gains and costs.*

Lots No.	Ration.	Year.	Total gain, winter and summer, per steer.	Cost per steer, winter.	Cost per steer, summer.[1]	Total cost of feed and pasture per year per steer.	Cost per pound yearly gain.
			Pounds.				
1	Corn silage, mixed hay, and wheat straw.	1914–15	313	$13.71	$8.40	$22.11	$0.070
		1915–16	344	13.74	8.35	22.09	.064
		1916–17	289	16.03	7.85	23.88	.083
	Average		316	14.49	8.20	22.69	.072
2	Corn silage, wheat straw, and cottonseed meal.	1914–15	328	14.47	8.40	22.87	.070
		1915–16	358	14.34	8.35	22.69	.063
		1916–17	310	14.60	7.85	22.45	.072
		1917–18	298	13.88	7.00	20.88	.070
	Average		324	14.32	7.90	22.22	.069
3	Mixed hay and wheat straw	1914–15	269	13.62	8.40	22.02	.082
		1915–16	303	15.03	8.35	23.38	.077
		1916–17	276	16.74	7.85	24.59	.089
		1917–18	249	17.30	7.00	24.30	.097
	Average		274	15.67	7.90	23.57	.086
4	Corn silage and soy-bean hay	1917–18	267	14.76	7.00	21.76	.081
5	Corn silage, rye hay, and cottonseed meal.	1917–18	292	16.82	7.00	23.82	.081

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[1] The cost of summer feed is calculated at the same rate for each lot each year, charging the pasture at 5 cents a day, as follows:

168 days, 1915	$8.40
167 days, 1916	8.35
157 days, 1917	7.85
140 days, 1918	7.00

The steers of Lots 2, which were fed corn silage, wheat straw, and cottonseed meal, made the greatest gains during the year at least cost for feed. Hence the cost of a pound of gain was lowest for these lots, the average for four years being 6.9 cents.

Lots 1, fed corn silage, mixed hay, and wheat straw, put on gains at an average cost of 7.2 cents a pound.

Steers fed mixed hay and wheat straw, which is by far the most commonly used ration in the section under discussion, made smaller yearly gains at greater cost than did the steers of the two lots aforementioned. It cost 8.6 cents to put on a pound of gain when the wintering ration consisted of mixed hay and wheat straw.

The cost of producing a pound of gain was comparatively high in Lots 4 and 5, being 8.1 cents a pound for each lot. The rations used, while an improvement over the commonly used combinations of mixed hay and wheat straw, were too costly, when resulting gains are considered, to be recommended except when mixed hay is not available.

VALUE OF GAINS.

In Table 10 the increase in value per steer is shown. The initial cost plus the cost of feed and pasture is the total cost of the steer at the close of the pasture season. The appraised valuation of the steers at this time was $2 per hundredweight more than the initial cost per hundredweight the preceding fall. While this is an arbitrary valuation, nevertheless it represents a very conservative figure, the actual increase in most instances being much more.

The cost of labor and other cost factors are not considered; such items would be more than offset by the value of the manure from the cattle.

TABLE 10.—*Summary of costs showing increased value of steers at end of winter feeding period.*

Lots No.	Year.	Initial value per steer.	Cost to feed each steer one year.	Value of steer, including cost of feed and pasture.	Appraised value of steer at end of year.	Increase over initial value plus cost of feed and pasture.
1	1914–15	$40.43	$22.11	$62.54	$79.48	$16.94
	1915–16	41.07	22.09	66.16	86.87	20.71
	1916–17	48.30	23.88	72.18	88.11	15.93
	Average	44.27	22.69	66.96	84.82	17.86
2	1914–15	40.17	22.87	63.04	80.50	17.46
	1915–16	44.07	22.69	66.76	88.06	21.30
	1916–17	48.30	22.45	70.75	90.00	19.25
	1917–18	50.33	20.88	71.21	92.06	20.85
	Average	45.72	22.22	67.94	87.66	19.72
3	1914–15	40.50	22.02	62.52	75.82	13.30
	1915–16	44.07	23.38	67.45	83.39	15.94
	1916–17	48.30	24.59	72.89	86.85	13.96
	1917–18	50.33	24.30	74.63	89.11	14.48
	Average	45.80	23.57	69.37	83.79	14.42
4	1917–18	50.33	21.76	72.09	91.49	19.40
5	1917–18	50.33	23.82	74.15	87.40	13.25

The estimated value per hundredweight at the end of the pasture season of all lots was the same, regardless of the extra finish due to greater gains made by the silage-fed lots. Steers from all lots were to be carried over and finished the following year; hence, no actual selling price is given. Had these increased gains been taken into consideration in estimating the value, the added profit per steer for the lots fed silage and cottonseed meal would have been even greater than the amounts shown in Table 10. In this table, as in all others, the steers of Lot 2, fed corn silage, wheat straw, and cottonseed meal, appear to best advantage, for they returned a profit of $19.72 per steer as compared with $17.86 for Lot 1 and $14.42 for Lot 3. Lots 4 and 5 were included in the table, but in the comparisons and conclusions drawn they are not considered, as they were carried only one year.

VALUE OF SILAGE IN THE RATIONS.

In Table 11 the added value per steer to be gained by the use of corn silage and also of cottonseed meal in the rations is shown. Since most of the cattle wintered in West Virginia and neighboring States are carried through on dry feed, the steers fed mixed hay and wheat straw were used as a basis from which to make comparisons and those feeds were considered a check ration.

The increased value of the steer in the spring over the fall value depends very largely upon the method of wintering, as is shown in Table 8, being from $1.40 to $2.85 per hundredweight. When the better methods are used the increase based upon the cost of wintering will be on the average about $2 per hundredweight, which is the figure used in making these calculations.

TABLE 11.—*Summary showing value of silage rations as compared with hay and straw (check ration).*

Ration.	Average yearly gain per steer.	Increased gain per steer over steers fed check ration.	Value of increase in gain per steer.	Average yearly cost of feed and pasture per steer.	Decrease in cost of ration as compared with check ration.	Increased value of ration per steer as compared with check ration.
	Pounds.	*Pounds.*				
Mixed hay and wheat straw (check ration)	274	....	....	$23.57	....	....
Corn silage, mixed hay, and wheat straw..	316	42	$3.73	22.69	$0.88	$4.61
Corn silage and soy-bean hay..............	267	7	[1] −.62	21.76	1.81	1.19
Corn silage, rye hay, and cottonseed meal..	292	18	1.60	23.82	[2] −.25	1.35
Corn silage, wheat straw, and cottonseed meal..............................	324	50	4.44	22.22	1.35	5.79

[1] Decrease.

[2] Increase.

The addition of corn silage to the dry-feed ration resulted in an increase of 42 pounds in the yearly gain of each steer as compared with the check ration, and the substitution of cottonseed meal and corn silage in place of mixed hay produced an increase of 50 pounds of gain per steer. At the estimated value—$2 margin above the initial cost per hundredweight—these additional gains would be worth $3.73 and $4.44, respectively. If the three rations had cost the same per steer per year, these figures would represent the added profit. With feeds at prices as charged during the first three years, however, the dry-feed ration was the most costly. It cost 88 cents less to feed a steer on corn silage, mixed hay, and wheat straw than on mixed hay and straw alone. The addition of cottonseed meal and the elimination of the hay decreased the cost $1.35. By adding these figures to the value of the increased gains, the total added profit per steer can be obtained. In the case of the steers fed corn silage, mixed hay, and wheat straw, this amounted to $4.61, and for the steers fed on corn silage, cottonseed meal, and straw the corresponding figure was $5.79.

Since the average initial weights of the lots were practically the same for each trial, and since all lots were summered on the same pasture, the difference in final weight can be attributed to the different rations fed during the winter.

GENERAL SUMMARY OF COSTS AND GAINS.

A general summary of costs and gains is given in Table 12.

TABLE 12.—*General summary of costs and gains.*

Items.	Lots 1, (corn silage, mixed hay, and wheat straw).	Lots 2, (corn silage, wheat straw, and cottonseed meal).	Lots 3, (mixed hay and wheat straw).	Lots 4, (corn silage and soybean hay).	Lots 5, (corn silage, rye hay, and cottonseed meal).
Average cost of wintering	$14.49	$14.32	$15.67	$14.76	$16.82
Average length of winter periods ... days	128	129¼	129¼	133	133
Cost of feed per day, winter	$0.116	$0.111	$0.121	$0.111	$0.127
Average cost of summer feed	$8.20	$7.90	$7.90	$7.00	$7.00
Average length of summer periods ... days	164	158	158	140	140
Cost per day, summer	$0.05	$0.05	$0.05	$0.05	$0.05
Average of total costs per year	$22.69	$22.22	$23.57	$21.76	$23.82
Average gain or loss per steer, winter ... pounds	−1	+62	−35	+27	+11
Average gain per steer, summer ... do	317	262	309	240	281
Average total gain per steer ... do	316	324	274	267	292
Cost per pound yearly gain	$0.072	$0.069	$0.086	$0.081	$0.081

CONCLUSIONS.

1. Corn silage, wheat straw, and cottonseed meal (fed to Lots 2) was the cheapest ration used and at the same time the best, making the greatest increase (62 pounds) in weight of the steers. It is seldom that one gets the best for the least money.

2. Silage added to a ration for wintering steers makes it more economical than dry roughage alone, considering the gains made both during the winter and in the summer following the winter feeding period.

3. With but few exceptions, a farmer or stockman (in the section considered) who has a sufficient number of mature cattle or their equivalent is justified in building a silo.

4. After the farmer or stockman has his silo he may advantageously buy a protein supplement. The quantity of cottonseed meal or other protein-rich feed would perhaps be regulated by the kind of roughage used with the silage. If a legume hay were used, the cottonseed meal or other protein concentrate could be eliminated entirely or at least reduced very materially in quantity.

5. The addition of corn silage to the ration for wintering yearling steers gave them an increased value of from $1.19 to $5.79 per head, depending upon the ration used.

6. As a general rule, where the farmer has silage and a roughage in the form of straw or various kinds of hay and stover, it would seem advisable to feed his yearling cattle (should he wish to winter them and sell them from grass the next summer) a ration of silage, a little cottonseed meal—not more than 1 to 1½ pounds—or other such feed, and the roughage that he has available.

7. The cost of wintering a yearling steer is approximately two-thirds the cost of keeping the steer one year. The profit, therefore, may be largely determined from the ration used and method of wintering.

8. The feeding methods used in wintering yearling steers added from $1.40 to $2.85 per hundredweight to the spring value over the value the preceding fall, depending upon the ration used.

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